

In re Patent Application of:
RAYNOR ET AL.
Serial No. 10/677,850
Confirmation No. 5132
Filing Date: OCTOBER 2, 2003

REMARKS

Applicants would like to thank the Examiner for the thorough examination of the present application. Claims 66-80 have been cancelled based upon the restriction requirement. The Applicants reserve the right to file a divisional application directed to the subject matter thereof.

The independent claims have been amended to include subject matter from respective dependent claims to more clearly define the present invention over the cited prior art references. These dependent claims have been cancelled, and the dependencies of certain other dependent claims have been amended accordingly. The claim amendments and arguments supporting patentability of the claims are provided below.

I. The Claims Are Definite

The Examiner rejected independent Claims 39 and 57 as being indefinite. The independent claims have been amended to recite that "at least one bump bond" is used to attach the sensor to the mounting substrate. Dependents Claims 42 and 59 each further recite that the attaching comprises heating the at least one bump bond.

With respect to attaching the housing to the mounting substrate in independent Claim 39, the Applicants submit that the claim is definite as currently written. Independent Claim 39 recites positioning the housing in contact with the mounting substrate. Once in contact, the housing may be held in place by gravity depending on its orientation, for example. Nonetheless, dependent Claims 50 and 51 each recite a type of "friction fit" for maintaining

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contact between the housing and mounting substrate. The Applicants respectfully submit that independent Claims 39 and 57 are definite.

II. The Amended Claims

Independent Claim 39 has been amended to include the subject matter from dependent Claim 42, and independent Claim 57 has been amended to include the subject matter from dependent Claim 59. Consequently, dependent Claims 42 and 59 have been cancelled.

The present invention, as recited in amended independent Claim 39, for example, is directed to method of attaching a sensor and a housing to opposite sides of a mounting substrate. The sensor has a sensing face and comprises a sensing area and at least one signal output contact thereon. The mounting substrate has a circuitry face and at least one signal input contact thereon. The mounting substrate also has an opening therethrough. The method comprising positioning the sensing area over the opening so that the at least one signal output contact of the sensor contacts the at least one signal input contact of the mounting substrate.

Amended independent Claim 39 further recites that the sensor is attached to the mounting substrate via the at least one bump bond interposed between the at least one signal output contact of the sensor and the at least one signal input contact of the mounting substrate to pass signals therethrough. The housing is positioned in contact with the mounting substrate so that the housing and the sensor are in

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alignment.

Using the at least one bump bond for attaching the sensor to the mounting substrate advantageously results in a more accurate alignment between the sensor and housing, while remaining inexpensive to perform in the sensor manufacture process. Moreover, the size of the final aligned sensor package does not compromise the size of the final aligned sensor package.

Independent Claim 57 has been amended similar to amended independent Claim 39, but does not recite the housing.

III. The Claims Are Patentable

The Examiner rejected independent Claims 39 and 57 over the Venkat et al. patent. The Examiner also rejected dependent Claims 42 and 59 over the over the Venkat et al. patent. Since the independent Claim have been amended to include the subject matter from dependent claims 42 and 49, discussion of amended independent Claims 39 and 57 will also be in view of the Venkat et al. patent.

The Venkat et al. patent discloses an integrated lens and aperture plate for an optical sensor equipped integrated chip in which the lens and the aperture plate are molded as one piece with the lens at the appropriate location so that the lens aligns with the location of the optical sensor. In particular, FIG. 2 in the Venkat et al. patent illustrates a sensor 32 being attached to a mounting substrate 36. The sensor 32 is attached via the pins extending therefrom by inserting the pins through the openings in the mounting substrate 36.

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As correctly noted by the Examiner, Venkat et al. fails to disclose the use of bump bonding for attaching the sensor to the mounting substrate. The Examiner has taken the position that the use of bump bonding in the assembly of integrated circuit and printed circuit board devices is well known in the art, thus making it obvious to a person of ordinary skill in the art to use bump bonding in the assembly of the claimed invention.

The Applications respectfully disagree that it would have been obvious to use bump bonding to attach a sensor to a mounting substrate. Paragraph 12 in the Applicants' specification describes how flip chip technology has not been used when manufacturing sensors.

While bump bonding may have taken a more commonplace role in image sensing today, it was not obvious to use bump bonding in the assembly of integrated circuit and printed circuit board devices in the construction of optical sensor devices. That is, the problem of having to have a sensor face exposed light teaches away from the use of flip chip technology and bump bonding.

The arrangements shown in FIGS. 1 and 2 in the Venkat et al. patent illustrate an optical sensor 10, 32 which comprises wire contacts for making connection with the PCB 12, 36. The wire contacts of the optical sensor 10, 32 are provided for engagement with a series of apertures on the face of the PCB 12, 36. One skilled in the art at the time the invention would infer that the wire bonds, together with their corresponding apertures, would be necessary for ensuring an accurate alignment of the optical sensor integrated circuit

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10, 32 with the PCB 12, 36.

In sharp contrast, the claimed invention uses at least one bump bond for attaching the sensor to the mounting substrate. In paragraph 17 of the Applicants' specification, the use of bump bonds are heated in a known manner to melt the solder into making an electrical connection between the signal output contacts of the image sensor 14 and the PCB lands 18. As the bump bonds melt they try to minimize forces in their surface tension, and thus deform evenly.

The Applicants have realized that the net effect of this action is to draw the image sensor into a precise alignment with the aperture. This is, the bump bonds provide an advantageous effect of actually improving the alignment of the sensor with the mounting substrate. This is not intuitively the case, as movement caused by the melting of the bump bonds would have normally been considered by one skilled in the art at the time of the invention to introduce a further inaccuracy or source of error in the alignment.

However, the Applicants have found that counter to these expectations, the bump bonds actually help with the alignment. A further advantage over the arrangement shown in the Venkat et al. patent is that extra holes do not need to be formed or drilled into the mounting substrate. Moreover, if it was obvious or known that bump bonds could be used for attaching a sensor to a mounting substrate, then there would have been prior art disclosing the claimed invention.

In addition, FIG. 2 of the Venkat et al. patent fails to illustrate positioning of a housing in contact with the mounting substrate so that the housing and the sensor are

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in alignment, as recited in amended independent Claim 39. Instead, Venkat et al. is directed to integration of the sensor with the integrated circuit before its attachment to the substrate.

Accordingly, it is submitted that amended independent Claim 39 is patentable over the Venkat et al. patent. Amended independent Claim 57 is similar to amended independent Claim 39. Therefore, it is submitted that this claim is also patentable over the Venkat et al. patent.

In view of the patentability of amended independent Claims 39 and 57, it is submitted that the dependent claims, which include yet further distinguishing features of the invention are also patentable. These dependent claims need no further discussion herein.

IV. CONCLUSION

In view of the amendments to the claims and the arguments provided herein, it is submitted that all the claims are patentable. Accordingly, a Notice of Allowance is requested in due course. Should any minor informalities need to be addressed, the Examiner is encouraged to contact the undersigned attorney at the telephone number listed below.

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Respectfully submitted,


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